

REMARKS

In the last Office Action, claims 9-11, 15, 17-23 and 29-30 were rejected under 35 U.S.C. §102(e) as being anticipated by Akiyama (U.S. Patent No. 6,542,208). Claim 16 was rejected under 35 U.S.C. §103(a) as being unpatentable over Akiyama.

Claim 29 was objected to because of a typographical error, and correction was required. The drawings were objected to under 37 C.F.R. §1.83(a) as not showing the "light-shielding object" recited in claim 10, and either correction of the drawings to show this feature or cancellation of this feature from the claim was required.

In accordance with this amendment, claim 10 has been canceled thereby overcoming the drawing objection. Independent claim 29 has been amended to correct the typographical error pointed out by the Examiner to make more clear that the liquid crystal display has only one reflection-polarizing plate.

Applicants respectfully submit that the cancellation of claim 10 and the minor amendments made to independent claim 29 do not raise a new issue that would require further search or consideration. The cancellation of claim 10 overcomes the drawing objection, and the amendment to claim 29 corrects a typographical error and more particularly points and

distinctly claims the invention by limiting the liquid crystal display device to one having a single reflection-polarizing plate, a limitation which was previously implicitly recited in the claim. This limitation was urged as a basis for patentability over Akiyama in the previous response (see page 17, last paragraph through page 19, first paragraph). Since the feature of the liquid crystal display device having only one reflection-polarizing plate has heretofore been considered by the Examiner, the inclusion thereof in base claim 29 does not raise a new issue requiring further search or consideration. Accordingly, entry of this amendment is respectfully solicited.

The present invention pertains to a liquid crystal display device for displaying information viewable by an observer from opposite sides of the device using incident light incident from only one of the sides of the device. While liquid crystal display devices offering two-sided viewing are known in the art, none uses incident light incident from only one direction. Instead, the conventional liquid crystal display devices that enable an observer to view the display from both the front and back sides generally require a separate light source, either a front light or a back light, or both. None uses only incident light incident from one side of the liquid crystal display device, as in the case of the present invention.

Independent claim 29 recites a liquid crystal display device for displaying information viewable by an observer from opposite sides of the device using incident light incident from only one of the sides. As shown, for example, in the embodiment of Fig. 1, the inventive liquid crystal display device has a liquid crystal panel 1 having two opposing substrates which sandwich therebetween a liquid crystal layer. The liquid crystal panel is driven in a manner well known in the art to change the direction of polarization of the polarized light passing therethrough at selected regions of the liquid crystal layer to produce display information. A polarizer 2 is disposed over a first side of the liquid crystal panel 1 for polarizing incident light 13 that is incident on the panel. A reflection-polarizing plate 3 is disposed over a second side of the liquid crystal panel 1 opposite the first side for receiving polarized incident light exiting the panel 1. No reflection-polarizing plate is disposed over the first side of the liquid crystal panel 1.

The incident light 13 that is polarized by the polarizer 2 and transmitted through the liquid crystal panel 1 undergoes a change in direction of polarization at selected regions thereof and is reflected by the reflection-polarizing plate 3 back through both the liquid crystal panel 1 and the polarizer 2 to enable an observer 11 to view the display

information from the first side of the liquid crystal panel (Fig. 1A). On the other hand, incident light 13 that is polarized by the polarizer 2 and transmitted through the liquid crystal panel 1 without undergoing a change in direction of polarization at selected regions thereof is transmitted through the reflection-polarizing plate 3 to enable an observer 12 to view the display information from the second side of the panel 1 (Fig. 1B).

Amended independent claim 29 differs from Akiyama in a seemingly simple though fundamentally significant respect. In the present invention, a reflection-type polarizer is present on only one side of the liquid crystal panel (LCD) whereas in Akiyama, a reflection-polarizing plate is present on both sides of the LCD. As described below, this results in a big difference in what can be viewed by an observer.

To assist in explaining the differences between the liquid crystal display device of the present invention as recited in base claim 29 and the liquid crystal display devices shown in Figs. 1 and 4 in Akiyama, reference is made to the accompanying Attachment in which Fig. A is an explanatory diagram showing the structure corresponding to the embodiment shown in Fig. 1 of Akiyama, Fig. B is an explanatory drawing showing the structure corresponding to the embodiment shown in Fig. 4 of Akiyama, and Fig. C is an

explanatory drawing showing the structure corresponding to the embodiment shown in Fig. 1 of the present application. In these explanatory figures, \oplus denotes non-polarized light, \ominus , \odot denote linearly polarized light having one polarizing direction, the left half of the LCD is shown in an OFF state (driving voltage is not supplied to the LC layer of this portion), and the right half of the LCD is shown in an ON state.

In Fig. A, incident light from the A-side, which is non-polarized light, will become linearly polarized light by passing through the absorption-type polarizer 10. In the OFF state region, the linearly polarized light is reflected by the reflection-type polarizer 9 because the polarizing direction of the linearly polarized light changes by passing through the LCD in the OFF state region. This reflected light (A-1) returns to the A-side. On the other hand, in the ON state region, the linearly polarized light passes through the reflection-type polarizer 9 and the absorption-type polarizer 11, and reaches the B-side. Incident light from the B-side, which is non-polarized light, will become linearly polarized light by passing through the absorption-type polarizer 11. In the OFF state region, the linearly polarized light is reflected by the reflection-type polarizer 8 and reaches the B-side as light (B-1). In the ON state region, the linearly

polarized light passes through the reflection type polarizer 8 and the absorption-type polarizer 10, and reaches the A-side. Therefore, if the A-side and the B-side are in a bright condition, light A-1 (through the OFF region) and light B-2 (through the ON region) reach the A-side, and light B-1 (through the OFF region) and light A-2 (through the ON region) reach the B-side. Then, an A-side observer and a B-side observer both see all the display area brightly, and can not distinguish the Off-portion from the On-portion, and can not recognize the displayed picture.

Similarly, in Fig. B, considering incident light from the A-side, light A-12 is reflected by the reflection-type polarizer 9 and returns to the A-side, and light A-11 passes through the reflection-type polarizer 9 and the absorption-type polarizer 11 and reaches the B-side. Considering incident light from the B-side, light B-12 is reflected by the reflection-type polarizer 8 and returns to the B-side, and light B-11 passes through the reflection-type polarizer 8 and the absorption-type polarizer 10 and reaches the A-side. Therefore, if the A-side and the B-side are in a bright condition, light A-11 (through the OFF region) and light B-12 (through the ON region) reach the B-side, and light B-11 (through the OFF region) and light A-12 (through the ON region) reach the A-side. Then, an A-side observer and a

B-side observer both see all the display area brightly, and can not distinguish the Off-portion from the On-portion, and can not recognize the displayed picture.

Thus in the Figs. 1 and 4 embodiments of Akiyama, only when either the A-side or the B-side is bright and the other side is dark, can an A-side observer and a B-side observer recognize the displayed picture. This is summarized in the following tables.

FIG.A		A-side circumstance	
		Bright	Dark
B-side circumstance	Bright	×	<ul style="list-style-type: none"> · A-side observer can see a posi-type picture · B-side observer can see a nega-type picture
	Dark	<ul style="list-style-type: none"> · A-side observer can see a nega-type picture · B-side observer can see a posi-type picture 	×

FIG.B		A-side circumstance	
		Bright	Dark
B-side circumstance	Bright	×	<ul style="list-style-type: none"> · A-side observer can see a nega-type picture · B-side observer can see a posi-type picture
	Dark	<ul style="list-style-type: none"> · A-side observer can see a posi-type picture · B-side observer can see a nega-type picture 	×

By contrast, in the case of the present invention shown in Fig. C, incident light from the A-side, which is non-polarized light, will become linearly polarized light by passing through the absorption-type polarizer. In the OFF state region, the linearly polarized light is reflected by the reflection-type polarizer because the polarizing direction of the linearly polarized light changes by passing through the LCD in the OFF state region. This reflected light (A-21) returns to the A-side. On the other hand, in the ON state region, the linearly polarized light (A-22) passes through the reflection-type polarizer, and reaches the B-side.

Incident light from the B-side having a polarizing direction the same as a transmission axis passes through the reflection-type polarizer and incident light having a polarizing direction the same as a reflection axis is reflected by the reflection-type polarizer. In the ON state region, the linearly polarized light passes through the reflection-type polarizer and reaches the A-side as light B-22. In the OFF state region, the linearly polarized light passes through the reflection-type polarizer and the LCD, and is absorbed by the absorption-type polarizer. Therefore, if the A-side and the B-side are in a bright condition, light A-21 (through the OFF region) and light B-22 (through the ON region) reach the A-side, and light A-22 (through the ON

region) and light b-2r (which is a reflected light by the reflection-type polarizer, in the On and Off portions) reach the B-side. Then, an A-side observer sees all the display area brightly, and can not distinguish the Off-portion from On-portion, and can not recognize the displayed picture. But, a B-side observer can readily distinguish the Off-portion from the On-portion, and can recognize the displayed picture. This is summarized in the following table.

FIG.C our invention		A-side circumstance	
		Bright	Dark
B-side circumstance	Bright	<ul style="list-style-type: none"> • A-side observer can not see a picture • <u>B-side observer can see a posi-type picture</u> 	<ul style="list-style-type: none"> • A-side observer can see a posi-type picture • B-side observer can not see a picture
	Dark	<ul style="list-style-type: none"> • A-side observer can see a nega-type picture • B-side observer can see a posi-type picture 	×

From the foregoing, it can be appreciated that the Akiyama liquid crystal display devices differ from the liquid crystal display device of the present invention as embodied in the claims. In accordance with the invention, the liquid crystal display device has only one reflection-polarizing plate, which is disposed over one side of the liquid crystal panel, whereas in the embodiments of Akiyama, two reflection-polarizing plates are required and are disposed over opposite sides of the liquid crystal panel. By virtue of this difference, the liquid crystal display device according to the present invention operates in different modes from those of Akiyama and achieves the objectives of the present invention. Since independent claim 29 includes a limitation not found in Akiyama, the reference cannot anticipate claim 29 or the claims dependent thereon.

Moreover, there is absolutely no teaching, suggestion or motivation in Akiyama, or the other references of record, that would have led one of ordinary skill in the art to modify the Akiyama liquid crystal display devices to eliminate one of the reflection-polarizing plates, as to do so would destroy Akiyama from functioning in its intended manner and would be totally contrary to and inconsistent with the entire disclosure of Akiyama.

In light of the foregoing, applicants respectfully request reconsideration and entry of this amendment together with withdrawal of the prior art rejection and passage of the application to issue.

Respectfully submitted,

ADAMS & WILKS
Attorneys for Applicants

By: 

Bruce L. Adams
Reg. No. 25,386

17 Battery Place
Suite 1231
New York, NY 10004
(212) 809-3700

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Debra Buonincontri

Name

Debra Buonincontri

Signature

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Date